WE CLAIM:

1. A method of implementing programmable optical add/drop multiplexing, the method comprising;

de-multiplexing, for each one of N optical systems, a respective input WDM (wavelength division multiplexed) optical signal into a plurality of optical path signals each comprising at least one channel;

performing an add/drop function of selected ones of the optical path signals and establishing through paths of remaining ones of the optical path signals;

multiplexing, for each one of the N optical systems, a plurality of optical path signals into an output WDM optical signal; and

performing at least one of chromatic dispersion compensation, slope of dispersion compensation and amplitude compensation wherein for each one of the N optical systems, a respective at least one of chromatic dispersion, slope of dispersion and amplitude of the output WDM optical signal is independent of the add/drop function and corresponds to a target value.

2. A method of implementing programmable optical add/drop multiplexing of N input WDM optical signals in an optical system, the method comprising;

introducing one or more dead-bands in each one of the N input WDM optical signals;

de-multiplexing each one of the N input WDM optical signals into a plurality of optical path signals each comprising at least one channel, wherein one or more of the

dead-bands are between two or more of the plurality of optical path signals;

performing an add/drop function of selected ones of the optical path signals and establishing through paths of remaining ones of the optical path signals; and

multiplexing respective ones of the optical path signals into N output WDM optical signals after the performing an add/drop function and the establishing through paths.

3. A method of implementing programmable optical add/drop multiplexing, the method comprising;

de-multiplexing, for each one of N optical systems, a respective input WDM optical signal into a plurality of optical path signals each comprising at least one channel;

performing an add/drop function of selected ones of the optical path signals and establishing through paths of remaining ones of the optical path signals;

multiplexing, for each one of the N optical systems, a plurality of optical path signals into an output WDM optical signal; and

establishing at least two paths of approximately equal optical path lengths between the de-multiplexing and the multiplexing.

4. A method according to claim **3** wherein the at least two paths of approximately equal optical path lengths are established by providing equivalent functional elements in the at least two paths of approximately equal optical path lengths.

5. A method according to claim **3** wherein the input WDM optical signals each carry a plurality of dead-bands in a

manner that channels of concurrent optical path signals of the optical path signals are separated by a respective one or more of the plurality of dead-bands, thereby resulting in mitigation of filtering penalties in de-multiplexing the input WDM optical signals and reducing cross-talk between the concurrent optical path signals.

6. A method according to claim **3** comprising establishing an express path at at least one of the through paths.

7. A method according to claim **3** further comprising performing chromatic dispersion compensation, wherein for each one of the output WDM optical signals of the N optical systems, the chromatic dispersion corresponds to a target value which is suitable for transmission requirements of a respective one of the N optical systems and wherein the target value is independent of the add/drop function.

8. A method according to claim **7** wherein the performing chromatic dispersion compensation comprises performing preliminary chromatic dispersion compensation and slope of dispersion compensation for each one of the input WDM optical signals of the N optical systems, wherein the input WDM optical signals are set to have common values of chromatic dispersion and slope of dispersion.

9. A method according to claim **7** wherein the performing chromatic dispersion compensation comprises performing output chromatic dispersion compensation and slope of dispersion compensation for at least one of the output WDM optical signals of the N optical systems, wherein for the at least one of the output WDM optical signals of the N optical systems the chromatic dispersion and the slope of dispersion are set to have target values of chromatic dispersion and slope of

dispersion, respectively, which are suitable for transmission requirements of a respective one of the N optical systems.

10. A method according to claim **7** wherein the performing chromatic dispersion compensation comprises performing secondary chromatic dispersion and slope of dispersion compensation for at least one optical path signal of each one of at least N-1 optical systems of the N optical systems, wherein respective optical path signals of the N-1 optical systems are set to have common values of chromatic dispersion and slope of dispersion.

11. A method according to claim **7** wherein the performing chromatic dispersion compensation comprises performing secondary chromatic dispersion and slope of dispersion compensation for at least one optical path signal of each of the input WDM optical signals of the N optical systems, wherein the chromatic dispersions and slopes of dispersion of the at least one optical path signal of each one of the input WDM optical signals of the N optical systems are set to have common values of chromatic dispersion and slope of dispersion.

12. A method according to claim **3** comprising performing amplitude compensation, wherein for each one of the output WDM optical signals of the N optical systems the power corresponds to target values which are suitable for transmission requirements of a respective one of the N optical systems and independent of the add/drop function.

13. A method according to claim **12** wherein the performing amplitude compensation comprises performing amplification of each one of the input WDM optical signals of the N optical systems, wherein the power of each one of the input WDM optical signals of the N optical systems is set to a common value.

14. A method according to claim **12** wherein the performing amplitude compensation comprises performing amplification of each one of the output WDM optical signals of the N optical systems, wherein for each one of the output WDM optical signals of the N optical systems, the power is set to a target value which is suitable for transmission requirements of a respective one of the N optical systems.

15. A method according to claim **12** wherein the performing amplitude compensation comprises performing amplitude compensation of at least one of the optical path signals of each one of the N optical systems, wherein for respective ones of the optical path signals of the N optical systems the power is set to a specific common value.

16. A method according to claim **3** wherein each one of a plurality of paths between the de-multiplexing and the multiplexing is established in a manner that the plurality of paths have equal optical path lengths.

17. A programmable optical add/drop multiplexer (OADM) comprising:

two or more OADM elements wherein each one of the OADM elements comprises a de-multiplexer (DeMUX) and a multiplexer (MUX) connected through a plurality of paths, wherein the DeMUX is adapted to de-multiplex an input WDM optical signal into a plurality of optical path signals each propagating through a respective one of the paths, and wherein the MUX is adapted to multiplex a plurality of optical path signals into an output WDM optical signal;

a plurality of switches each connected to respective ones of the paths of the two or more OADM elements, wherein the switches are adapted to perform an add/drop function of

selected ones of the optical path signals of the two or more OADM elements and establish through paths of remaining ones of the optical path signals of the two or more OADM elements; and

at least one of a plurality of dispersion and slope of dispersion compensation modules (DSCMs), a plurality of optical amplifiers and a plurality of variable gain control elements (VGCEs), wherein the DSCMs are adapted to perform at least one of dispersion compensation and slope of dispersion compensation in a manner that, for each one of the two or more OADM elements, the dispersion and slope of dispersion, respectively, of the output WDM optical signal is independent of the state of the switches and wherein the optical amplifiers and the VGCEs are adapted to perform amplitude compensation in a manner that, for each one of the two or more OADM elements, the amplitude of the output WDM optical signal is independent of the state of the switches.

18. An optical system comprising:

at least one transmitter adapted to generate optical signals each comprising one or more channel wherein channel frequencies at which the optical signals are generated are limited to provide dead-bands; and

a programmable optical add/drop multiplexer (OADM) comprising:

two or more OADM elements wherein each one of the OADM elements comprises a DeMUX and a MUX connected through a plurality of paths, wherein the DeMUX is adapted to de-multiplex an input WDM optical signal into a plurality of optical path signals with at least one of the dead-bands between at least two of the optical path signals, each one of the optical path signals propagating through a respective one

of the paths, and wherein the MUX is adapted to multiplex a plurality of optical path signals into an output WDM optical signal; and

a plurality of switches each connected to respective ones of the paths of the two or more OADM elements, wherein the switches are adapted to perform an add/drop function of selected ones of the optical path signals of the two or more OADM elements and establish through paths of remaining ones of the optical path signals of the two or more OADM elements.

19. A programmable OADM comprising:

two or more OADM elements wherein each one of the OADM elements comprisies a DeMUX and a MUX connected through a plurality of paths, wherein the DeMUX is adapted to de-multiplex an input WDM optical signal into a plurality of optical path signals each propagating through a respective one of the paths, and wherein the MUX is adapted to multiplex a plurality of optical path signals into an output WDM optical signal;

a plurality of switches each connected to respective ones of the paths of the two or more OADM elements, wherein the switches are adapted to perform add/drop function of selected ones of the optical path signals of the two or more OADM elements and establish through paths of remaining ones of the optical path signals of the two or more OADM elements; and

optical path length means for reducing effects of coherent cross-talk between the optical path signals.

20. A programmable OADM according to claim **19** wherein, the optical path length means for reducing effects of coherent cross-talk comprises at least two of the paths having approximately the same optical path length.

21. A programmable OADM according to claim **20** wherein functional elements within any one of the at least two of the paths are equivalent to other functional elements within any other one of the at least two paths.

22. A programmable OADM according to claim **19** wherein the optical path length means for reducing effects of coherent cross-talk comprises each one of the paths having approximately the same optical path length.

23. A programmable OADM according to claim **19** wherein the optical path means for reducing effects of coherent cross-talk comprises applying the programmable OADM to input WDM optical signals each carrying a plurality of dead-bands in a manner that channels of concurrent optical path signals of the optical path signals are separated by a respective one or more of the plurality of dead-bands, thereby resulting in mitigation of filtering penalties in de-multiplexing the input WDM optical signals and reducing coherent cross-talk between the concurrent optical path signals.

24. A programmable OADM according to claim **19** further comprising means for chromatic dispersion compensation connected to at least one of the two or more OADM elements, wherein the chromatic dispersion of each one of the output WDM signals corresponds to a respective target value and is independent of the state of the switches.

25. A programmable OADM according to claim **24** wherein the means for chromatic dispersion compensation comprises, for each one of the two or more OADM elements, a primary DSCM connected to a respective one of the DeMUXs, wherein the primary DSCM is adapted to perform chromatic dispersion and slope of dispersion compensation of a respective one of the input WDM optical signals, wherein the chromatic dispersion and slope of

dispersion of each one of the input WDM optical signals is set to a common value of chromatic dispersion and slope of dispersion, respectively.

26. A programmable OADM according to claim **24** wherein the means for chromatic dispersion compensation comprises, for at least one of the two or more OADM elements, an output DSCM connected to a respective one of the MUXs, wherein the output DSCM is adapted to perform chromatic dispersion compensation of a respective one of the output WDM optical signals, wherein the chromatic dispersion of the respective one of the output WDM optical signals is set to a respective target value of chromatic dispersion.

27. A programmable OADM according to claim **26** wherein the output DSCM is further adapted to perform slope of dispersion compensation of the respective one of the output WDM optical signals, wherein the slope of dispersion of the respective one of the output WDM optical signals is set to a respective target value of slope of dispersion.

28. A programmable OADM according to claim **24** wherein the means for chromatic dispersion compensation comprises one or more secondary DSCMs each connected through a respective one of paths of all but one of the two or more OADM elements, wherein each one of the secondary DSCMs is adapted to perform secondary chromatic dispersion compensation of a respective one of the optical path signals, wherein the chromatic dispersion of the respective one of the optical path signals is set to a value which is equal to a value of chromatic dispersion of a respective optical path signal of a remaining one of the two or more OADM elements.

29. A programmable OADM according to claim **24** wherein the means for chromatic dispersion compensation comprises one or

more secondary DSCMs in each one of the two or more OADM elements, wherein the secondary DSCMs are connected through a respective one of the paths and wherein the secondary DSCMs are adapted to perform secondary chromatic dispersion and slope of dispersion compensation of respective ones of the optical path signals, wherein the chromatic dispersion and slope of dispersion of the respective ones of the optical path signals are set to common values of chromatic dispersion and slope of dispersion, respectively.

30. A programmable OADM according to claim **19** comprising means for amplitude compensation, wherein the power of the output WDM signals of the two or more OADM elements is independent of the state of the switches.

31. A programmable OADM according to claim **30** wherein the means for amplitude compensation comprises, for each one of the two or more OADM elements, an input amplifier connected to a respective one of the DeMUXs, wherein the input amplifier is adapted to amplify a respective one of the input WDM optical signals, wherein the powers of the input WDM optical signals are set to a common value.

32. A programmable OADM according to claim **30** wherein the means for amplitude compensation comprises, for each one of the two or more OADM elements, an output amplifier connected to a respective one of the MUXs, wherein the output amplifier is adapted to amplify a respective one of the output WDM optical signals to a required target value of power that satisfies transmission requirements of an optical system associated with a respective one of the two or more OADM elements.

33. A programmable OADM according to claim **30** wherein the means for amplitude compensation comprises a plurality of VGCEs each connected through a respective one of the paths of the two

or more OADM elements, each one of the VGCEs being adapted to perform amplitude compensation of a respective one of the optical path signals, wherein the powers of the respective ones of the optical path signals are set to a common value.

34. A programmable OADM according to claim **33** wherein at least one of the VGCEs is adapted to perform a mute function of a respective one of the optical path signals.